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HABITAT USE AND MANAGEMENT OF PILEATED WOODPECKERS IN NORTHEASTERN OREGON

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Abstract: We determined home range size and habitats used by pileated woodpeckers (*Dryocopus pileatus*) to provide essential information for proper management of the species in northeastern Oregon. Twenty-three pileated woodpeckers fitted with transmitters were followed for 5–10 months (Jun–Mar) during 1989–90. Mated pairs (n = 7) ranged over smaller areas ($\bar{x}$ = 407 ha) than birds ($\bar{x}$ = 597 ha) whose mates had died (n = 9). Habitat use within home ranges was not random. Stands with old growth, grand fir (*Abies grandis*), no logging, and ≥60% canopy closure were used more ($P < 0.01$) than expected, and all other types of stands were used less than expected. From June until March, 38% of the observations of foraging were on downed logs, 38% on dead trees, 18% on live trees, and 6% on stumps. We recommend that management for pileated woodpeckers in northeastern Oregon include increasing density of snags for nesting and foraging, increasing density of downed logs in foraging areas, and increasing management areas from the existing 121 ha to 364 ha of forest. Within these areas, we recommend that 75% be in grand fir forest type; 25% be old growth; and the remainder be mature stands; at least 50% have ≥60% canopy closure; and at least 40% be unlogged with the remainder in mature stands.

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The pileated woodpecker was selected as a management indicator species for older forests by some regions in the U.S. Forest Service because it nests and roosts in large-diameter dead trees or snags (Hoyt 1957, McClelland 1977, Harris 1982, Bull et al. 1992*b*), and is largely dependent on dead wood (standing and down) for foraging (Bull 1987). These habitat components are most common in older forests.

Management for pileated woodpeckers on public lands in the western United States has been based on guidelines that recommend leaving specified densities of snags for nesting and roosting to provide for different population levels of woodpeckers (Thomas et al. 1979, Brown 1985). In addition, 121-ha patches of older forests have been maintained for nesting pairs on National Forests in the Pacific Northwest Region. Neither of these management approaches has been tested, however, to ascertain whether it supports the woodpecker in eastern Oregon.

Research conducted elsewhere suggests that the 121-ha management areas are inadequate in coniferous forests. Radio-tagged pileated woodpeckers in western Oregon had home ranges of 257–1,056 ha (Mellen et al. 1992). In contrast, radio-tagged birds in Missouri used only 53–160 ha during April–August (Renken and Wiggers 1989). However, this research was conducted in deciduous forests that are typically more diverse than coniferous forests, so a comparison of home range sizes is not valid.

We felt it necessary to determine population density of pileated woodpeckers in 9 study areas with different snag densities to test the snag guidelines currently in use, and to test the existing guidelines for 121-ha management areas maintained in old-growth conditions in the Pacific Northwest Region.

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STUDY AREAS

We ascertained pileated woodpecker density and snag density in 7 study areas on the Wallowa-Whitman and Umatilla National forests and in 2 study areas on private land in Union and Wallowa counties. We named the study areas: Spring, Bear, Syrup, Balm, Little, Mac, Wallowa, Ukiah, and Pelican. The first 5 areas were used only in 1989 and the others in 1990. We ascertained sizes of home ranges of radio-tagged pileated woodpeckers in the first 7 study areas listed. All study areas were large enough for 2–4 pairs of pileated woodpeckers (1,457–1,624 ha), were between 900 and 1,800 m in elevation, and contained a mosaic of mixed-coniferous stands containing ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), grand fir, and lodgepole pine (*Pinus contorta*) interspersed with scattered grasslands. We chose areas to study with a broad array of snag densities, and our selections were based on our perception of approximate snag densities. Methods for determining snag densities and habitat composition of study areas are described in the Habitat Quantification section.

Wallowa was 11 km north of Wallowa, Oregon, and had the lowest snag density (2.9 snags $\geq$25 cm dbh/ha) of all the study areas. Ninety-one percent of the area had been logged with a partial overstory removal 20–30 years ago. The logging resulted in only 7% of the area remaining in old growth.

Spring was 16 km west of La Grande, Oregon, and had the second lowest snag density (3.3/ha), the greatest area in ponderosa pine forest type (76%), the least area in old growth (3%), and the most logging activity (93% of area recently logged in clearcuts and partial overstory removals) of all the study areas.

Balm and Little were 38 km southeast and 11 km east of Union, Oregon, respectively. Both Little and Balm had 12% of their area in old growth, 43–44% of their areas in stands with canopy closures $\geq$60%, and intermediate snag densities. Little had 7.6 snags/ha, 26% of the area in ponderosa pine, and 21% of the area with little or no logging. Balm had 4.7 snags/ha, 2% of the area in ponderosa pine, and 31% of area with little or no logging. The remainder of these areas had been logged with partial overstory removals.

Bear and Syrup were both on the Starkey Experimental Forest, 35 km southwest and 35 km west–southwest of La Grande, Oregon, respectively. Both had 13% of their areas in ponderosa pine. Because <10% of the areas had been logged in the previous 35 years, there were high densities of snags (10.4 and 9.4 snags/ha), >50% of the stands had $\geq$60% canopy closure, and 20–31% of the stands were old-growth.

Mac was 26 km west of La Grande, Oregon, and contained 7.6 snags/ha. Twenty percent of the area was unlogged or had been high-graded, and the rest had shelterwood cuts and recent overstory removals. Only 11% of the stands were in old growth.

Ukiah was 17 km west of Ukiah, Oregon, and contained 7.5 snags/ha. Most of the area (94%) had been logged (clearcuts, shelterwoods, partial overstory removals) within the last 20 years, only 7% of the stands were old growth, and only 14% had canopy closures $\geq$60%.

Pelican was 16 km northwest of La Grande, Oregon, and contained 10.3 snags/ha. Thirteen percent of the stands were old growth, 23% had little or no logging, and only 26% had canopy closures $\geq$60%. The areas that had been logged had clearcuts, shelterwoods, and partial overstory removals.

METHODS

Woodpecker Survey

We surveyed each of the 9 study areas for pileated woodpeckers in the spring. Five areas were surveyed in 1989 and four in 1990. We surveyed for woodpeckers along variable-width transects that were established approximately every km, so we came within 0.5 km of all places within each study area. There were 2–3 transect lines in each area; the average length of a transect was 8 km. Total length of transects in each area ranged from 15 to 26 km. Surveys were conducted for 3–5 hours, beginning 1 hour after sunrise between 26 March and 9 May each year. Surveys were not done on days with precipitation or wind (>15 km/hr). A survey consisted of a person slowly walking the transect and stopping every 0.5 km for 5 minutes to listen and watch for pileated woodpeckers. If none were heard, we vocally imitated the territorial call (a series of loud "whucks") every 30 seconds to elicit a response. All transects in 1 study area were surveyed on the same day, and each transect was walked only once.

A relative index of pileated woodpeckers was calculated from line transect data in each study area by dividing the total number of birds detected by the transect length (km). Absolute density was not calculated because the birds often flew to the observer before they were detected, which violates an assumption required in determining density from transect data.

We also obtained a total count of pairs of pileated woodpeckers by locating all nesting pairs in each area. Each study area was intensively searched for 30–50 person-days using techniques described by Bull et al. (1990*a*). We are confident all nesting pairs were located. All nests (n = 29) were verified as containing incubating adults or nestlings except three, which we think failed before they were verified. The total count of nesting pairs was converted to pairs per 100 ha of forest for comparison.

Habitat Quantification

In each study area we ascertained snag density, percent of area by forest type, successional stage, logging activity, and canopy closure. We mapped the different habitat components by using aerial photo interpretation (Avery 1978) and stand examinations in the field. A planimeter was used to determine area in each mapped category.

Forest stands were classified by plant series into 3 forest types (ponderosa pine, Douglas-fir, and grand fir) described by Johnson and Hall (1990). We classified a stand as ponderosa pine type if it contained predominantly (>90% of all trees) or exclusively ponderosa pine. Stands in the Douglas-fir type usually contained a mixture of ponderosa pine and Douglas-fir. Stands in the grand fir type contained grand fir and often Douglas-fir, western larch, ponderosa pine, and lodgepole pine.

Forested stands in the study areas were predominantly uneven-aged, thereby making classification into successional stages difficult. We classified stands as young if 90% of the trees were <30 cm in dbh. Old-growth stands contained ≥12 trees/ha that were ≥51 cm dbh in the grand fir type or >8 trees/ha ≥51 cm dbh in the ponderosa pine and Douglas-fir types. Old-growth stands were multilayered and had ≥60% canopy closure. Stands that contained trees ≥30 cm dbh but did not have any trees ≥51 cm dbh or did not have enough to qualify as old growth were considered mature.

All the study areas had received some logging. We defined 3 categories of logging activity: unlogged or high-graded stands that were logged 20–50 years ago with only the valuable large-diameter seral tree species harvested (also called economic selective harvest; Wellner 1978); clearcuts or shelterwood cuts (removal of all the mature timber in a series of cuttings that usually take place within 10 years of each other); and partial overstory removal where 20–40% of the basal area had been removed within the last 20 years; these stands were still forested with an uneven-aged distribution of trees but typically lacked large-diameter trees. The high-graded stands in category 1 were usually fully stocked, and large-diameter trees, particularly grand fir, were common. We classified canopy closure as 0–10%, 11–59%, and ≥60%. Canopy closure for stands was estimated from aerial photographs (Avery 1978).

In 6 study areas, we ascertained the density of snags ≥51 cm dbh (and ≥6 m tall) from a complete count (Bull et al. 1990*b*), and derived the density of snags 25–50 cm dbh (and ≥2 m tall) by averaging counts made at 40 0.4-ha plots. The locations of the plots were determined by placing a 0.5-km grid over an aerial photograph of each area. A partial count of snags was done in the remaining 3 areas because of time constraints. In these 3 areas, density of all snags ≥25 cm dbh was estimated by counting snags on 165 0.4-ha plots. The plots were located as described previously.

We recorded species, dbh, height, and decay class for each snag ≥51 cm dbh in all 9 areas. We classified snags relative to decay classes as recent-dead, if bark and branches were still on the tree; long-dead, if bark and branches were gone and the wood was soft; or intermediate-dead, if the tree did not fit into the first 2 categories. We did not record information about species, dbh, height, or decay class for snags 25–50 cm dbh.

A complicating factor in evaluating snag densities was the occurrence of the western spruce budworm (*Choristoneura occidentalis*) and

Douglas-fir beetle (*Dendroctonus pseudotsugae*) which were in outbreak status in Bear and Syrup when we counted snags. Insects are an important mechanism for providing snag recruitment over time; however, the outbreak resulted in unusually high densities of Douglas-fir snags that were too new to have influenced pileated density. We counted all snags but also noted which ones probably resulted from the outbreak, so that the snag density could be adjusted for those 2 areas.

We used a stepwise multiple regression to evaluate the relationship between density of pileated woodpeckers (pairs/100 ha) and habitat characteristics. A separate analysis was run for forest type, successional stage, logging activity, canopy closure, snags ≥51 cm dbh/ha, and snags 25–50 cm dbh/ha. We used linear regression to compare pileated density and snags ≥51 cm dbh/ha. A probability level of $P \leq 0.05$ was used to denote significance.

Radio Telemetry

We radiotagged 25 nesting pileated woodpeckers in 1989 (3 pairs each in Bear, Syrup, Little, and Balm and 1 member of a pair in Spring) and six in 1990 (2 pairs in Mac and 1 pair in Wallowa). Once nests were found during the survey, we selected 1–3 pairs (depending upon the number of nests located and their accessibility for trapping) in each study area to radiotag. The same procedures were used in both years for locating, radiotagging, and following the birds.

We trapped 28 woodpeckers at their nest cavities when nestlings were 7–15 days old. In addition, 2 woodpeckers were trapped at roost trees in July and one in November. Adults were trapped with a hoop net on a pole, or with a board mounted on a rattrap (Bull and Pederson 1978) placed over the entrance hole.

Each bird was equipped with an 11-g, 2-stage transmitter attached with a backpack harness. The transmitters lasted 5–6 months. All birds were recaptured at roost trees in November or December to replace the transmitters. All the birds except two, whose transmitters failed, were retrapped after another 5–8 months to remove the transmitters.

Each radio-tagged bird was followed 2–3 times/week from July through September and once each week from October until March. When birds were followed, they were located every 10 minutes and habitat characteristics were recorded in a 0.4-ha plot (using bird location as the center of the plot), if we could see the bird or if we knew that the bird was within 75 m based on aural detection of foraging activity. If we could not find the bird within 10 minutes of when the previous plot had been recorded, we continued searching and took a plot when we found it. In 1989, we attempted to record 10 plots while following each bird. In 1990, we recorded 5 plots/follow. At each plot we recorded date, time, forest type, successional stage, logging activity, canopy closure, and snow depth. A spherical densiometer (Strickler 1959) was used to measure canopy closure.

If we could see the bird, we recorded behavior as foraging, calling or drumming, resting, with juveniles, or other. If the bird was foraging, we recorded its activity, the stratum upon which it was foraging, the tree species, dbh, height or length, and decay class of the stratum, and height of bird above ground. Foraging activity was classified as excavating or digging into the interior wood, pecking in the bark, or gleaning on the surface of trunks or branches. Foraging stratum was classified as live tree, dead tree (≥2 m tall), stump (<2 m tall), or downed log. Diameter of logs was recorded 1.3 m from the largest end. The same decay classes described for snags were used to classify logs.

We analyzed the average data for each bird, rather than for all observations combined, so that each bird was weighted equally and the experimental unit became the individual bird. Some birds were more easily observed than others, so numbers of foraging observations were not equal. We included data only for birds that survived ≥3 months.

The location of all plots for 1 bird during 1 follow were recorded on an overlay of an aerial photograph and then transferred to an overlay of follows for the year. We used the minimum convex polygon method to determine home range size for each bird. Only birds followed on at least 35 different days were included in the home range determination.

We determined density of downed logs and dead trees within 12 home ranges by quantifying the logs (>15 cm at base and >2 m long) and dead trees (>15 cm dbh and >2 m tall) within 20 plots (20 × 20 m) within each home range. We placed 10 of the 20 plots where pileated woodpeckers had been observed foraging (during follows), and ten randomly within the home range (selected from a grid on an aerial photograph). We could not determine density of downed logs and dead trees in the 3 other home ranges due to time constraints and because logging activities had changed the densities.

For each territory, we used Friedman's test (Conover 1980, Alldredge and Ratti 1992) and a nonparametric separation test to compare the species, diameter, and decay class of available logs versus logs where birds had been observed feeding. Similarly, we compared species and diameter of snags that were available versus snags upon which birds had been observed feeding. Analyses were limited to birds with ≥20 observations of feeding on the strata being considered. We used multiple stepwise regressions to determine the variables that best predicted size of home range. Size of home range was the dependent variable, and forest types, successional stages, logging activities, and canopy closure categories were the independent variables.

RESULTS

Bird Density

Fifty-two pileated woodpeckers were heard on transects, and 29 nesting pairs were found in all 9 areas (Table 1). The number of pileated woodpeckers heard on transects gave a good approximation of the number of nesting pairs found ($R^2 = 0.95$) (Bull et al. 1990*a*). Denisty of snags ≥51 cm dbh was the best predictor of density of pileateds ($F = 7.49$; 1, 7 df; $P < 0.05$) (Table 1). The regressions on logging activity ($F = 16.7$; 1, 7 df; $R^2 = 0.70$, $P < 0.01$), canopy closure ($F = 9.67$; 1, 7 df; $R^2 = 0.60$, $P = 0.02$), and successional stage ($F = 10.04$; 1, 7 df; $R^2 = 0.59$, $P = 0.02$) also were significant. Pileated abundance increased as the amount of forests with no logging, ≥60% canopy closure, and old growth increased.

Home Range Size

We included home ranges of 23 birds in the calculation of home range size. These birds were followed an average of 53 days (range = 36–64 days), with an average of 563 plots/woodpecker (range = 196–876), and a total of 12,951 plots for all birds.

Both members of 7 pairs were followed 5–10 months, and their home ranges averaged 407 ha (SD = 110.35, range = 321–630); 364 ha were forested, and the rest were openings. Size of home ranges of the male and female of each

Table 1. Density of pileated woodpeckers and snags, northeastern Oregon, 1989–90.

Study area	Nesting pairs		Snags/100 ha	
	n	n/100 ha[a]	≥51 cm[b]	25–50 cm[c]
Bear	7	0.5	266	675
Syrup	5	0.39	176	869
Little	4	0.27	34	725
Balm	3	0.2	41	431
Mac	3	0.22	141	617
Ukiah	3	0.2	86	662
Pelican	2	0.14	132	903
Wallowa	1	0.08	15	275
Spring	1	0.07	16	312

[a] Forested ha only.
[b] Hard and soft snags ≥51 cm and ≥6 m tall; this density was the best predictor of density of pileateds ($F = 7.49$; 1, 7 df; $P < 0.05$; linear regression).
[c] Hard and soft snags 25–50 cm dbh and ≥2 m tall.

pair were very similar to the size of their combined home range. The home ranges of both males and females averaged 88% (male: SD = 0.08, range = 76–97%; female: SD = 0.10, range = 75–97%) of the home ranges of the pairs.

The home range of 9 birds whose mates died within 3 months of radiotagging averaged 597 ha (SD = 388.12, range = 200–1,464 ha); an average of 540 ha were forested. Although this average home range is larger than that of pairs, the home ranges were not significantly different between pairs and singles. One of these birds had a home range of 1,464 ha, which was more than double that of any other bird. If that bird was excluded, the home ranges averaged 489 ha (SD = 226.88, range = 200–689 ha), of which 442 ha were forested.

We followed 2 adjacent pairs in two of the study areas and did not observe any overlap in home ranges. In Syrup, we followed 1 pair and 2 males whose mates had died and observed almost no overlap among these birds (Fig. 1). However, a fourth pair (Rock pair; Fig. 1) nested within a portion of Syrup male's home range, so it is likely that the home ranges of these pairs overlapped. We followed 3 radio-tagged pairs in Balm. From June through September, the home ranges of Gulch female (whose mate had died) and Romeo male overlapped 46% (Fig. 2A). This overlap was reduced to 13% from October until March (Fig. 2B). The Romeo male apparently was attempting to pair with Gulch female even though a third bird, another female (called Vamp), was often with them. Vamp and Gulch fought on 26 September, and Vamp eventually chased the other bird away. Afterwards,

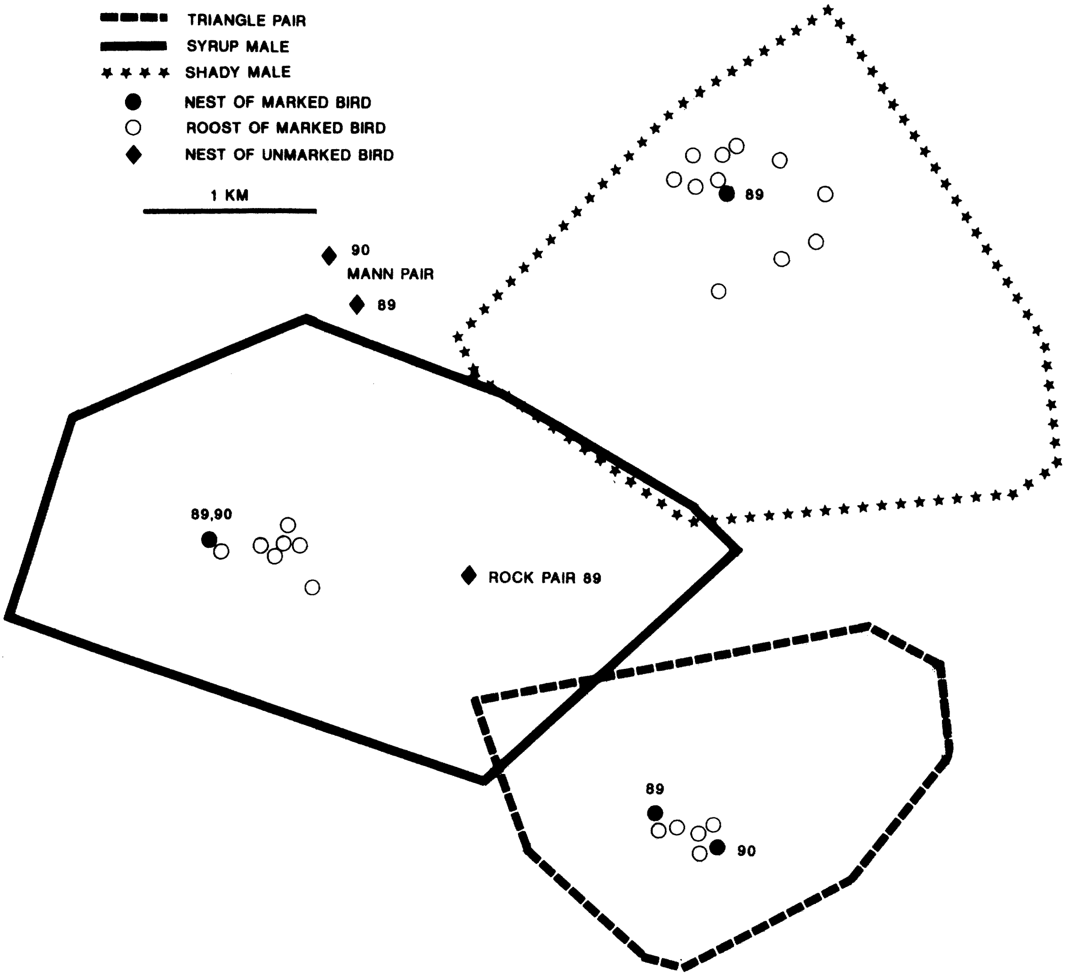

Fig. 1. Home ranges, nests, and roosts of 4 radio-tagged pileated woodpeckers, Syrup study area, northeastern Oregon, 1989-90. Numerals indicate year.

Romeo and Gulch were never seen together; each of their ranges was smaller with less overlap, and Romeo nested with Vamp the following year. Romeo and Vamp were radiotagged in July and November, respectively, and we did not know if they nested together the previous year. The overlap between the Knob pair and Romeo was <2% and between Knob pair and Gulch female overlap was 11%.

Habitat Within Home Range

Habitat available within the home ranges varied with size of home range (Table 2). Smaller home ranges tended to have a higher percentage of area in grand fir, old growth, unlogged stands, and stands with ≥60% canopy closure. The percentage of forest type in ponderosa pine was the variable best able to predict home range size ($R^2 = 0.78$, $P < 0.01$). The addition of a second variable did not significantly increase R^2. As area in the ponderosa pine forest type increased, home range increased, suggesting that the ponderosa pine forest type was poor habitat. Selection of this variable was largely influenced by the bird with the largest home range because 76% of that range was in ponderosa pine, and no other bird had >32% of their range in pine. When we ran the regression excluding that bird, the same variable was selected as the best predictor but with a much lower R^2 (0.27, $P = 0.01$).

Pileated woodpeckers did not use habitat within their home ranges at random. For this analysis, we included an additional 2 birds (total of 25 birds) that were followed 19 and 31 days

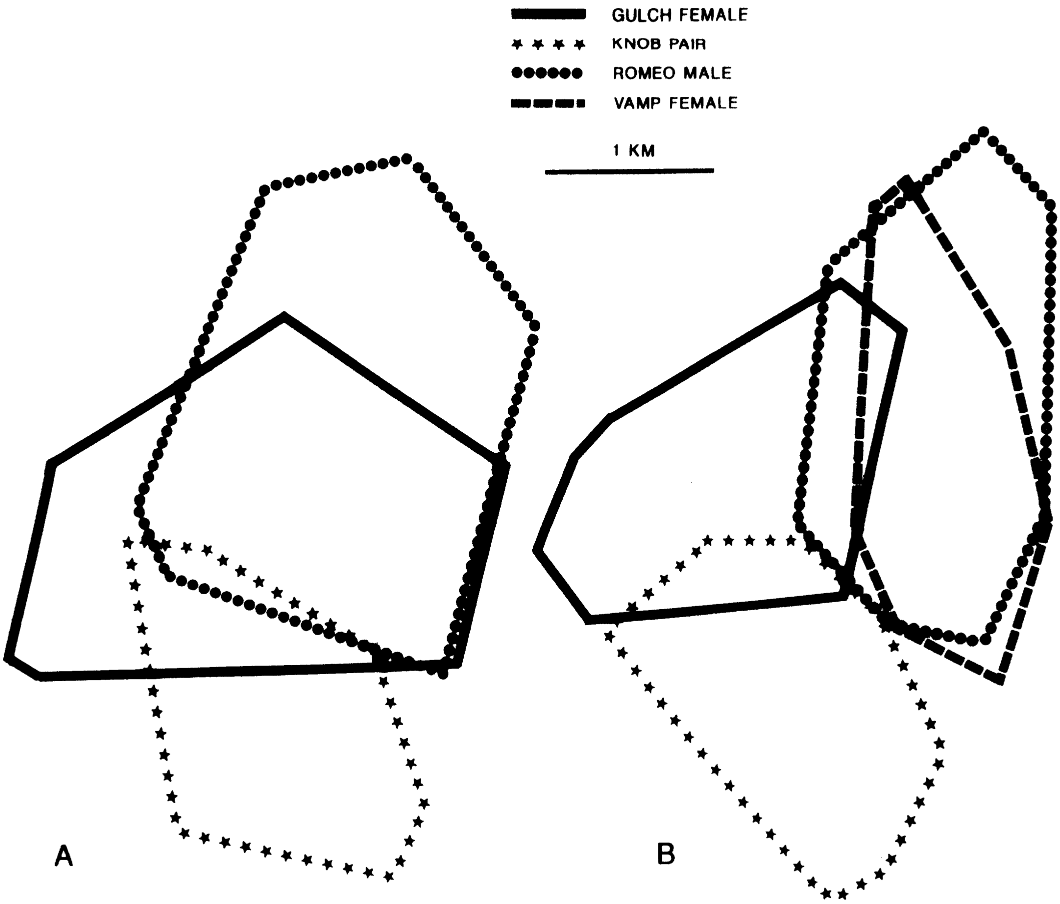

Fig. 2. Home ranges of radio-tagged pileated woodpeckers from (A) June through September (n = 4), and (B) October through April (n = 5), Balm study area, northeastern Oregon, 1989–90.

(206 and 348 observations), respectively. All birds used stands with old growth (F = 22.92; 2, 48 df; P < 0.01), grand fir (F = 52.74; 2, 48 df; P < 0.01), no logging (F = 24.08; 2, 48 df; P < 0.01), and >60% canopy closure (F = 203.27; 2, 48 df; P < 0.01) more than expected based on availability. They also used all other types of stands less than expected.

Foraging Behavior and Habitat

We observed birds at 42% of 13,505 plots recorded for 25 pileated woodpeckers. About half of the 42% were observations of foraging. The remainder of the activities were resting (20%), calling or drumming (13%), with juveniles (12%), or other (5%). Resting activity usually seemed to result from the bird knowing we were there; the bird often stopped foraging and perched in a tree and waited for us to leave.

Of the foraging observations, 53% were excavating, 32% were pecking in bark, 10% were gleaning, and 5% were a combination of these. For all foraging observations, 38% were of pileated woodpeckers feeding on logs, 38% on snags, 18% on live trees, and 6% on stumps. There was a mean density of 290 downed logs/ha in the 240 plots sampled in the 12 home ranges. Thirty-seven percent of these logs (107/ha) showed evidence of recent or old pileated woodpecker foraging on them.

Characteristics of foraging strata differed (Table 3). Douglas-fir and western larch were favored, lodgepole pine was avoided, and the other tree species were used in proportion to their availability (F = 5.98; 5, 45 df; P < 0.01). Both logs ≥38 cm in diameter (F = 3.28; 3, 33 df; P = 0.03) and long-dead logs were preferred (F = 47.67; 2, 22 df; P < 0.01). Ponderosa pine,

Table 2. Habitat characteristics (averages) within the home ranges and within 4 size classes of home ranges of pileated woodpeckers, northeastern Oregon, 1989–91.

Characteristic	All pairs	Home range size class (ha)			
		<300	300–499	500–799	>800
n (home ranges)	7	3	6	6	1
Home range (ha)	407	220	370	647	1,464
Home range (forested ha only)	364	208	345	566	1,324
Forest type series (%)[a]					
Ponderosa pine[b]	3	2	2	13	68
Douglas-fir	23	27	19	34	26
Grand fir	74	71	79	53	5
Successional stage (%)[a]					
Young	6	0	5	4	8
Mature	70	59	71	67	88
Old growth	24	41	22	29	4
Logging activity (%)[a]					
None	43	81	38	64	9
Partial	49	19	53	34	81
Shelterwood	8	0	9	2	10
Canopy closure (%)[a]					
<10%	8	1	7	4	15
10–59%	41	24	43	52	68
≥60%	51	75	50	44	17

[a] Values are percentage composition of the home ranges.
[b] Best predictor ($R^2 = 0.78$; $P < 0.01$; stepwise multiple regression) of home range size.

Douglas-fir, and western larch snags were preferred ($F = 7.48$; 5, 75 df; $P < 0.01$). Snags ≥38 cm dbh also were preferred ($F = 63.05$; 3, 45 df; $P < 0.01$).

Dead standing trees and logs were particularly important for foraging, yet their use changed over the year (Fig. 3). When we compared foraging strata without snow (≤5 cm) with foraging strata with snow (>5 cm), we noted an increase in use of live trees (17–22%), an increase in use of dead trees (35–55%), a decrease in use of logs (41–18%), and a slight decrease in use of stumps (7–5%).

DISCUSSION

We believe that home ranges did not overlap a great deal except in situations when birds had lost mates. Birds whose mates had died usually had more overlap and larger home ranges than did pairs. These birds may have expanded their ranges to search for mates, or to forage over larger areas because of poorer habitat.

We were unable to predict size of home range very accurately with the habitat variables. However, the birds did not use habitat within their home ranges at random and selected for stands with old growth, grand fir, no logging, and >60% canopy closure. Similarly, Conner (1980) reported that pileated woodpeckers in Virginia used the oldest stands with the highest basal area and density of stems available for foraging.

The snag densities in the study areas were variable, and while we did not consider some areas (Spring and Wallowa) capable of supporting self-sustaining pileated populations, we felt others (Bear and Syrup) were self-sustaining and capable of acting as sources for other areas because of the high density of pairs (7 and 5 pairs, respectively) and successful reproduction (75% of nesting pairs fledged young). We estimated that 16% of the snags ≥51 cm in Bear and Syrup had resulted from activity of spruce budworm or Douglas-fir beetle, so 16% of the snag density can be subtracted from the total to yield a density without the influence of an insect outbreak. We were unable to judge the ability of the remaining areas to support self-sustaining pileated populations because of only 1 year of observations and very variable reproduction.

Our observations of foraging differed somewhat from observations in the eastern United States. Conner (1980) reported more snags (49%) and live trees (45%) and fewer downed logs (1%) used by pileateds for foraging in Virginia. Con-

Table 3. Characteristics of foraging strata (%) where pileated woodpeckers were observed foraging, and characteristics of available logs and snags that were measured at 240 plots (20 × 20 m) in 12 home ranges, northeastern Oregon, 1989–91.

Characteristic	Downed log		Snag		Live tree observed
	Observed	Plots	Observed	Plots	
Tree species[a]					
Grand fir	23	28	47	75	41
Douglas-fir	25	6	21	9	21
Ponderosa pine	30	27	16	5	16
Western larch	20	14	14	7	21
Other[b]	2	25	2	4	1
Dbh (cm)[c]					
<25	26	46[d]	8	59[d]	9
25–37	34	33	26	27	27
38–50	24	12	30	9	29
≥51	16	8	36	5	35
Decay class[e]					
Recent-dead	1	18	24		
Intermediate-dead	23	66	61		
Long-dead	76	16	15		
n	995	2,779	1,030	558	484

[a] Species of logs ($F = 5.98$; 5, 45 df; $P < 0.01$; Friedman's) and snags ($F = 7.48$; 5, 75 df; $P < 0.01$; Friedman's) not used in proportion to availability.
[b] Primarily lodgepole pine.
[c] Diameter classes of logs ($F = 3.28$; 3, 33 df; $P = 0.03$; Friedman's) and snags ($F = 63.05$; 3, 45 df; $P < 0.01$; Friedman's) not used in proportion to availability.
[d] Limited to 15–24 cm dbh.
[e] Long-dead logs preferred ($F = 47.67$; 2, 22 df; $P < 0.01$; Friedman's).

ner (1979*a*) also reported a variety of foraging strategies for pileateds with the majority of excavation occurring in winter, and more pecking and scaling occurring during the spring and summer. Excavation involved gaining access to interior wood where the woodpeckers fed primarily on ants, probably carpenter ants (*Camponotus* spp.) and some thatching ants (*Formica* spp.) (Bull et al. 1992*a*). Pecking the bark may have uncovered some ants (*Lasius, Leptothorax*) and beetles that occurred under the bark rather than in the interior wood (T. R. Torgersen and E. L. Bull, unpubl. data). Tree gleaning occurred primarily in June and July on live Douglas-fir and grand fir when the birds were probably feeding on larvae of western spruce budworm. We found budworm mandibles in woodpecker scats (Bull et al. 1992*a*).

We observed pileated woodpeckers gleaning branches of live Douglas-fir and grand fir that were infested with western spruce budworm larvae in June and July. This timing coincided with the highest use of live trees (42%) that we observed and also coincided with the greatest abundance of the large, late-instar budworms (Fellin and Dewey 1986). Use of live trees again increased from November to January when we observed woodpeckers frequently excavating at the base of live western larch. We think they were feeding on carpenter ants in these larch because ant galleries were evident in some of them. Conner (1981) also noted pileateds feeding on carpenter ants near the base of live trees in winter.

Use of snags was greatest in the winter, presumably because logs became inaccessible when snow covered them. Shallow snow apparently did not preclude use of logs because we observed birds wiping snow off logs with their bills and then feeding in the log.

MANAGEMENT IMPLICATIONS

Past management for pileated woodpeckers followed guidelines presented by Thomas et al. (1979) that were based on providing specified snag densities in 121-ha territories. These guidelines were based on the best knowledge available at the time. From our findings, we now know that 121-ha areas are much smaller than observed pair home ranges, and habitat components other than snags are important in managing for pileated woodpeckers in northeastern Oregon. Management plans for pileated woodpeckers should be revised to incorporate this new information.

We recommend using an average home range

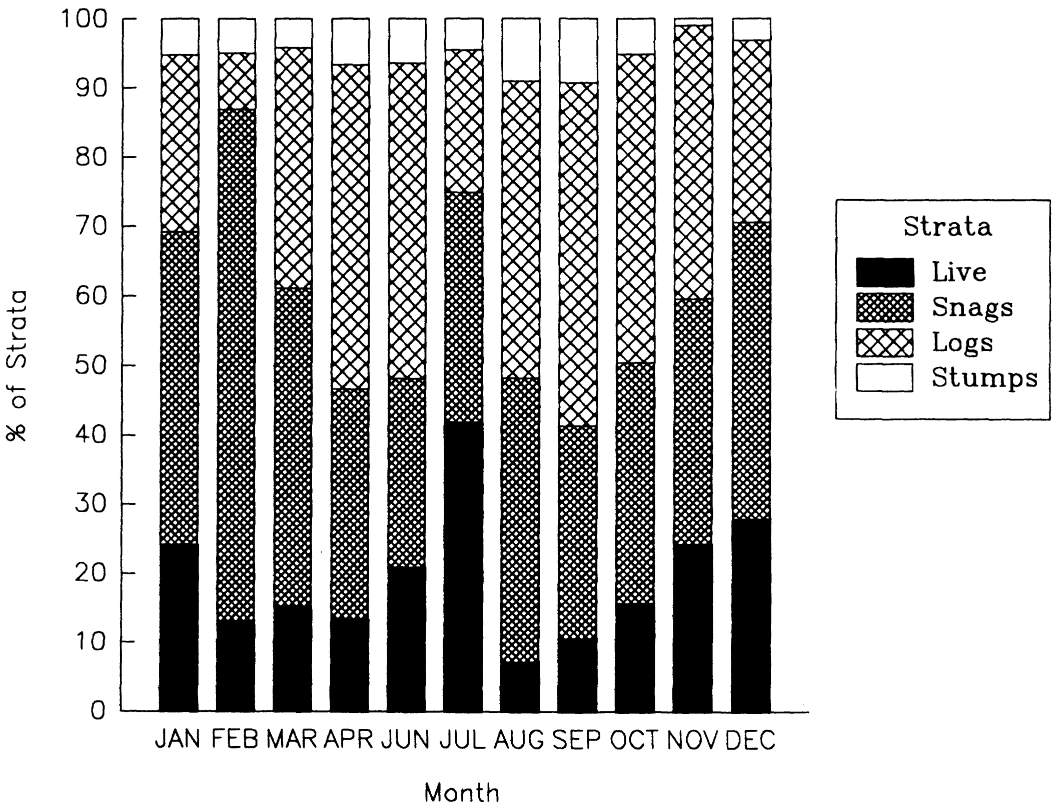

Fig. 3. Monthly foraging strata used by radio-tagged pileated woodpeckers, northeastern Oregon, 1989–91.

size of 364 ha of forest, more than 3 times the size of current prescribed management areas. Within those home ranges, we recommend that about 75% be in the grand fir forest type; at least 25% be old growth and the remainder be mature; at least 50% of the area should have ≥60% canopy closure; at least 40% of the area should remain unlogged, with the remainder having no more than partial overstory removals so mature stands are retained after logging.

Downed logs were a critical component of the foraging habitat, but only 37% showed evidence of pileated woodpecker feeding. We recommend leaving ≥100 logs/ha in management areas, with a preference for logs ≥38 cm in diameter (long-dead logs) and for all species except lodgepole pine. We also recommend leaving ≥8 snags/ha for nesting, roosting, and foraging; at least 20% of these snags should be ≥51 cm dbh.

The existing pileated management areas (121 ha) on National Forests are about 8 km apart. If only 1 pair of pileateds occurs in each management area, and there is 1 management area for every 4,860 ha, then only 2% of the total forest is being managed for pileated woodpeckers. Additionally, our observations indicate that isolated pairs in marginal (i.e., minimum standard) habitats are unlikely to sustain a population. This information suggests that larger blocks of habitat (for >1 pair), in closer proximity, should be managed for pileateds to provide self-sustaining populations. Such management action is similar to that recommended for the northern spotted owl (*Strix occidentalis*) (Thomas et al. 1990), and would increase the probability of birds finding new mates because if 1 member of a pair dies, the surviving mate does not leave the territory.

Managing for minimum levels of a species is risky (Conner 1979*b*). Consequences can be unfortunate when new data reveal that current recommendations are inadequate to provide the population levels desired, because other options often have been eliminated. Therefore, we recommend managing clusters of 3 or more pairs in 1 block of habitat with blocks distributed across the landscape through time. This management should include the appropriate forest types, successional stages, logging activities, canopy closures, snag densities, large-diameter live trees, and downed log densities within a larger home range area.

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